Emotion

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Unique Affective Profile of Music-Evoked Nostalgia: An Extension and Conceptual Replication of Barrett et al.'s (2010) Study

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Nostalgia is a mixed emotion, often evoked by music. This study sought to conceptually replicate and extend Barrett et al.'s (2010) pioneering work exploring music-evoked nostalgia, where the authors identified person- and context-level predictors of the experience of nostalgia in music. In a sample of 582 adults across the United States, we identified self-selected nostalgic and musically matched nonnostalgic, familiar songs for each individual, using an online survey in 2021. The participants listened to music and indicated feelings of valence and arousal, followed by assessments of affect (Positive and Negative Affect Schedule, Short Form) and personality (Ten-Item Personality Inventory, Brief Affective Neuroscience Personality Scales, and Southampton Nostalgia Scale). Nostalgic songs were rated higher in valence and arousal than familiar, nonnostalgic control songs, and higher in mixed valence in some metrics. Individuals with higher trait-level Trait Nostalgia reported higher nostalgia ratings across nostalgic and control songs. Interactions between context- and person-level factors indicated that personality influenced the felt valence and arousal profile of music-evoked nostalgia, distinct from familiar control music. While some personality types found nostalgic music to make them feel more aroused and positive (those high in care, trait nostalgia, anger), others felt more negative while listening (those high in sadness). Last, we extend the personality profile of a highly nostalgic person; trait-level Trait Nostalgia was associated with care, play, agreeableness, extraversion, and neuroticism. We demonstrate affective and person-level contributors to music-evoked nostalgia observed in Barrett et al.'s (2010) hold even when controlling for familiarity and musical features. We provide novel insights on complex interactions supporting this emotion, in a larger and more diverse sample with personalized stimuli.

Keywords: music, emotion, nostalgia, affect, personality

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Nostalgia is a mixed emotion (Hepper et al., 2024; Holak & Havlena, 1998; Turner & Stanley, 2021), eliciting primarily positive (Hepper et al., 2012; Leunissen et al., 2021; Sedikides et al., 2015; Wildschut et al., 2006) and peripherally negative (Hepper et al., 2012; Holak & Havlena, 1998; Turner & Stanley, 2021) feelings, and is often accompanied by an autobiographical memory (Wildschut et al., 2006). While conceptualizations have varied across the past 3 centuries (Batcho, 2013), nostalgia is defined today as "a wistful or excessively sentimental yearning for a return to or of some past period or irrecoverable condition" (Merriam-Webster, 2022) and "a feeling of pleasure and also slight sadness when you think about things that happened in the past" (Cambridge Dictionary, 2024). Nostalgia may serve several adaptive functions, including fostering a sense of meaning (Routledge et al., 2008, 2012), solidifying identity (Sedikides et al., 2016; Sedikides, Wildschut, Gaertner, et al., 2008), buffering against existential threats (Juhl et al., 2010), and counteracting loneliness (Abeyta et al., 2020; Zhou et al., 2008). Nostalgia can be triggered by feeling states such as loneliness or sadness (Wildschut et al., 2006) and by external stimuli such as smell (Matsunaga et al., 2011; Reid et al., 2015) or music (Barrett et al., 2010; Gibbs & Egermann, 2021; Mehnert, 2018; Sedikides et al., 2022; Sterenberg, 2018).

Music-evoked nostalgia is commonly reported by individuals across the age spectrum (Hanson et al., 2022) and cultures

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Sarah Hennessy and Timothy Greer contributed equally to this work.

Sarah Hennessy played a lead role in conceptualization, formal analysis, funding acquisition, project administration, and writing–original draft and an equal role in data curation and methodology. Timothy Greer played a lead role in software and an equal role in data curation, methodology, and writing–review and editing. Shrikanth Narayanan played a supporting role in supervision and an equal role in writing–review and editing. Assal Habibi played a lead role in supervision, a supporting role in funding acquisition and methodology, and an equal role in writing–review and editing.

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(Hanson et al., 2022; Hepper et al., 2024; Saarikallio et al., 2021). When the participants are asked to indicate discrete emotions experienced when listening to music, nostalgia is consistently top-ranked, surpassed only by general "liking" of a song (Jakubowski & Ghosh, 2021). The affective signature of music-evoked nostalgia is mixed, yet unevenly; music-evoked nostalgia is reported as more positive than negative (Barrett et al., 2010). In everyday life, this affective experience may depend on the context in which nostalgia is evoked (Barrett et al., 2010; Newman & Sachs, 2020) and the individual-level characteristics of the listener (Barrett et al., 2010).

Barrett et al. (2010) in *Emotion*

Music-evoked nostalgia, including its content, triggers, and psychological effects, has been explored in depth for the past decade. These investigations are largely rooted in the work of Barrett et al. (2010), who published the first comprehensive investigation of music-evoked nostalgia in *Emotion*. The authors investigated factors that may contribute to the nostalgic listening experience, laying out a heuristic model consisting of context-level (i.e., song familiarity, experienced emotions, autobiographical memories) and person-level (i.e., personality traits, Trait Nostalgia, mood state) factors. The primary aim was to identify to what extent context-level factors, person-level factors, and their interactions predicted the experience of music-evoked nostalgia. The participants completed a battery of person-level measures, including personality questionnaires, followed by listening to thirty 15-s musical clips and indicating associated felt emotions and memories.

Results indicated that the magnitude of music-evoked nostalgia was most strongly predicted by context-level factors (i.e., familiarity, memory association, valence) but was also predicted by person-level measures (i.e., trait-level Trait Nostalgia). Interactions between context- and person-level effects broadly indicated that Trait Nostalgia most consistently interacted with context-level measures, amplifying observed context-level effects. Last, the authors investigated the relationship between Trait Nostalgia and other measured personality traits, observing that Trait Nostalgia was predicted by trait-level sadness and neuroticism. As a whole, this study has laid the groundwork for understanding music-evoked nostalgia. Music-evoked nostalgia is a mixed emotion, highly influenced by contextual factors. It is also tied to person-level factors such as Trait Nostalgia, which may, in turn, be part of a complex profile of personality. This influential article has stood as the foundation for subsequent investigations on music-evoked nostalgia over the past 13 years.

Aims of the Present Study

The major aim of the present study was to explore whether the findings of Barrett et al.'s (2010) *Emotion* article would be replicated in a larger, more diverse sample. The present study aimed to extend this work in three main ways: (a) broadening the *sample*, (b) using *updated scales*, and (c) *personalizing* music. We expanded the sample of the previous work ($N = 226$, University of California, Davis, psychology undergraduate students) by including a larger group of participants ($N = 582$), recruited from across the United States, and spanning across a broader range of ages and locations. We used several updated versions of scales, including the Brief Affective Neuroscience Personality Scales (BANPS; Barrett et al., 2013) instead of the full-length Affective Neuroscience Personality Scales (Davis et al., 2003). We additionally modified the report of subjective feeling to allow for continuous, bilateral measures of affective arousal and valence. Dimensional affect models have been shown to capture mixed feelings in musical stimuli better than discrete measures (Eerola & Vuoskoski, 2011). We believe that these methods also account for the limitation as discussed by Barrett et al. (2010), in which the intensity of felt emotions was not measured while allowing for the capture of a more complex, less discrete, affective response to characterize music-evoked nostalgia. Last, we personalized musical stimuli for each participant. Barrett et al. (2010) utilized the Billboard Top 100 to select songs that may or may not elicit nostalgia from participants. These methods may not capture the broad and heterogeneous array of music preferences observed across individuals. With the obsoletion of radio and the ubiquity of online streaming platforms today, individuals' most nostalgic music is likely outside the limits of most popular songs. We instead utilized a novel method of stimulus selection, involving both self-report and a machine-learning algorithm, that ensures that (a) all participants have a set of highly personalized, autobiographically salient, nostalgic songs and (b) all participants also have a set of nonnostalgic pieces of music that are still familiar. We additionally controlled for release date and acoustic features to ensure that each stimuli pair differed only on nostalgia. In this way, we seek to understand which person and context-level features may differ between nostalgic songs and nonnostalgic, yet familiar, musically matched songs. We note that methodological differences deem this work a conceptual (not direct) replication and extension. These differences are noted in the Method section. We hypothesize that findings observed in Barrett et al.'s (2010) study will be replicated in the present investigation, even when controlling for musical features and song familiarity, and in a larger and more diverse sample.

Method

This study and all protocols were approved by the University of Southern California's institutional review board (IRB), and all methods were carried out by the IRB's guidelines and regulations. All data were collected and analyzed anonymously. The requirement to obtain informed consent from all participants was waived by the IRB's ethics committee due to the anonymity of data collection. The participants read an informational page at the beginning of the study, describing study procedures, risks, and benefits, and were instructed to leave the survey if they did not wish to continue participation.

Transparency and Openness

We report how we determined our sample size, all data exclusions, all manipulations, and all measures in the study below, and we follow the Journal Article Reporting Standards (Kazak, 2018). All data and analysis code are available at https://osf.io/864nx/. Data were analyzed and visualized using R, Version 4.0.5 (R Core Team, 2021), and the packages *ggplot* (Wickham, 2016) and *lme4* (Bates et al., 2015). This study's design and its analysis were not preregistered.

Power Analysis

To determine the minimum sample size needed to detect an estimated small person and context-level interaction effect in our

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planned multilevel models, we conducted a power analysis with the following parameters using the R package *simr* (Green et al., 2023): Cohen's $f^2 = 0.3$, $\alpha = .05$, power ≥ 0.8. A minimum sample size of 550 participants was needed.

Participants

The participants were 582 adults residing in the United States (see Table 1 for demographic characteristics). The participants were recruited via https://www.Prolific.co (Palan & Schitter, 2018) on December 13, 2021. Prolific.co is an online research platform with over 100,000 participants globally who are vetted for their reliability. Inclusion criteria were as follows: (a) fluent in English, (b) residing in the United States, and (c) over the age of 18 years. The participants were screened so that an equal number of males and females participated. After removing 14 participants for improper responses (failed attention checks or completing the survey too quickly), 754 participants remained. The participants who had zero appropriately matched control songs (see the Statistical Analysis section) were excluded ($N = 172$), leaving 582 participants included in the final analysis.

Procedure

The participants completed one online survey (~1 hr long), displayed via *Qualtrics* (Qualtrics, 2020). The participants were instructed to complete the survey in a quiet space with speakers or headphones. Audio quality was tested at the beginning of the survey. The survey contained three main phases:

1. Musical selection
    a. reporting three nostalgia-inducing songs
    b. listening to each of the self-reported nostalgic songs and up to four candidate control songs as identified by the Control Song Selection model (see Supplemental Methods)
2. Context-level measures
    a. appraising songs based on familiarity, felt nostalgia, felt valence, and felt arousal
3. Person-level measures
    a. completing personality and demographic measures

Table 1
Demographic Characteristics of Study Sample

Variable	%
Age	
M (*SD*)	33.19 (13.25)
Gender	
Female	48
Male	49
Nonbinary	3
U.S. region of residence	
West	37
Midwest	18
South	29
Northeast	16
Country of childhood	
United States	95
Other	5

Deviating from Barrett et al. (2010), we chose to place person-level measures at the end of the online survey rather than at the beginning. This selection was motivated by two factors: (a) Due to the volume of songs and responses, the participants were asked to attend the music selection and context-level sections; we wanted to maintain participant attention for these sections by placing them earlier in the survey. (b) We wanted to avoid any inadvertent priming that may have occurred by prompting the participants to think about self and personality that may have later impacted feeling responses to the music. Additionally, after each nostalgic song, the participants were asked to write a brief description of the memory that was evoked by the song. Results from these data will be reported in a future report. After completion of the survey, the participants were thanked for their time and compensated, on average, $4.55 USD (at the 2021 Prolific minimum rate of $6.37 per hour).

Materials

Musical Stimuli

At the beginning of the survey, the participants were given a definition of nostalgia ("sentimental longing for the past") and of a nostalgia-evoking song ("a song that brings you back to a pleasant moment or era of your life and evokes a strong memory"). Then, they were asked to complete a comprehension check, in which they were asked to choose the definition of nostalgia and of a nostalgia-evoking song, "as this study defines it" from a list of five, randomly shuffled, options (see Supplemental Methods). The participants were only allowed to continue once they had chosen the correct response. Then, the participants were asked to enter three personally nostalgia-inducing songs and their artists. These songs were fed into our previously described Control Song Selection model (see Supplemental Methods) to identify Control songs that were musically similar, familiar, but nonnostalgic to the individual participant. Each control song was musically matched to its nostalgia song seed based on computationally derived, expressed valence (within 0.15 out of 1 point) and energy (within 0.15 out of 1 point) and was released within 5 years of the seed song. This matching procedure aimed to ensure that songs between conditions were matched for acoustic features and familiarity, which may consequently control for enjoyment, as preference for certain acoustic features (Rentfrow et al., 2011) and familiarity is associated with liking a piece of music. Each participant had a final set of three nostalgic and up to three control songs, which they listened to in a random order during the survey.

The survey and Control Song Selection model were created and presented using *Qualtrics* (Qualtrics, 2020) and SpotifyAPI (Lamere, n.d.). JavaScript was used to embed the Control Song Selection tool into the back end of the Qualtrics survey. This script and a web-based version of this tool are publicly available at https://osf.io/864nx/ and https://www.soundslikethis.us.

Context-Level Measures

After each nostalgia and control song, participants were asked to rate the musical clip for familiarity (*Not at all familiar*, *Somewhat*

familiar, *Very familiar*) and whether the song made them feel on a scale from 1 (*not nostalgic at all*) to 9 (*extremely nostalgic*). Then, the participants were asked to rate each song for felt valence using a two-part Likert question ("Rate how positive the emotion was that you FELT while listening to the song" and "Rate how negative the emotion was that you FELT while listening to the song") and arousal using a two-part Likert question ("How activated was the emotion that you FELT while listening to the song" and "How deactivated was the emotion that you FELT while listening to the song"). "Activation" was chosen to describe arousal to capture embodied feeling states, in which a highly arousing emotion is associated with highly activated, strong bodily sensations and a less arousing emotion is associated with deactivation and weaker bodily sensations (Nummenmaa et al., 2014). This language was taken directly from the circumplex model (Posner et al., 2005) and has been successfully used in other investigations involving self-report of emotional arousal (e.g., Presti et al., 2022). Both sets of questions were on a scale of 0–10. As described above, the level of felt nostalgia was also obtained (on a 9-point scale, ranging from *not at all nostalgic* to *extremely nostalgic*) after listening to each musical piece.

Person-Level Measures

After the musical stimulus presentation, each subject filled out several surveys related to nostalgia, personality, and affect. Surveys were presented in random order but maintained the original order of questions within each task.

To assess the general mood state at the time of the survey (during the past week), we administered the Positive and Negative Affect Schedule, Short Form (PANAS-SF; Watson et al., 1988). The PANAS-SF consists of 10 items assessing positive affect and 10 items assessing negative affect. The participants were asked to indicate to what extent they felt each emotion (e.g., excited or irritable) in the past week on a 5-point scale ranging from *very slightly or not at all* to *extremely*. Values for positive and negative items were averaged to create one positive affect and one negative affect score for each participant.

We administered the seven-item version of the Southampton Nostalgia Scale (SNS; Sedikides et al., 2015), a measure frequently used to assess trait-level nostalgia (Barrett et al., 2010; Routledge et al., 2008). This task asks the participants to rate, on a 7-point scale ranging from 1 (*not at all*) to 7 (*very much*), their experience of nostalgia in daily life. Items include questions related to nostalgia's importance ("How significant is it for you to feel nostalgia?") and proneness ("How often do you feel nostalgia?"). Scores across all items are averaged (with one backward-scored item) to create one Trait Nostalgia score for each participant.

To assess the five-factor model of personality, we administered the Ten-Item Personality Inventory (TIPI; Gosling et al., 2003). In this task, the participants identify the extent to which they view themselves across five dimensions (openness, conscientiousness, extraversion, agreeableness, stability [previously, neuroticism]) with 10 items rated on a 10-point scale ranging from *disagree strongly* to *agree strongly*. Each item includes a forward-scored and a reverse-scored word pair for the participants to relate to, such as "reserved, quiet" and "extraverted, enthusiastic." Scores for each of the five factors are averaged to create one score for each factor for each participant.

We additionally administered the Brief-Affective Neuroscience Personality Scales (Barrett et al., 2013). This scale assesses six affective neurobiological systems of play, seek, care, fear, anger, and sadness. The scale has 33 items, in which participants are asked to indicate how much they agree with each statement (e.g., "When I am frustrated, I usually get angry.") on a 5-point scale ranging from *strongly disagree* to *strongly agree*. Scores are averaged within each of the six systems, resulting in six final scores for each participant.

Each subject also indicated their age, gender, and country of residence for the majority of their childhood. Two attention checks were given throughout the survey, ensuring high-quality results.

Statistical Analysis

For all analyses, only complete pairs of nostalgia and control songs were included; inputted nostalgia songs that did not have appropriately matched control songs (i.e., the Control Song Selection procedure failed for that song) were excluded. The participants in which no appropriate control songs were identified for any nostalgia songs were excluded. Statistical analyses were performed in R Version 4.0.5 (R Core Team, 2021) using RStudio. To compute standard linear regressions, we used the *lm* function of base R. To compute mixed multilevel models, we used the *lmer* function from *lme4* (Bates et al., 2015). While Barrett et al. (2010) used SAS with SAS PROC MIXED to perform mixed models, we contend that the *lmer* function in R is computationally comparable (Bates, n.d.). Models were fit with restricted maximum likelihood estimation and an unstructured variance/covariance structure, as in Barrett et al. (2010). For all models, effect size for individual fixed effects was calculated using Cohen's f^2 (Cohen, 1992).

Context-Level Measures

To explore differences in context-level variables (nostalgia rating, felt arousal, felt valence, mixed valence) between the nostalgia and control conditions, we used mixed-effects multilevel regression models. Raw values were used for context-level measures in this analysis. Mixed valence was calculated using two different functions: (a) the Griffin formula (Thompson et al., 1995), calculated by capturing the intensity and similarity of both positive and negative emotions ($[\text{Positive} + \text{Negative}]/2 - |\text{Positive} - \text{Negative}|$), and (b) the minimum function (MIN; Schimmack, 2001), which is derived from the minimum of the positive and negative values, corresponding to the intensity of the less-dominant emotion. Two measures of mixedness were included to capture different aspects of mixed feeling; while Griffin is most sensitive to the similarity of two feelings, the minimum function is most sensitive to the intensity of the mixedness. In the multilevel models, songs were clustered within each participant, with a random intercept included for participant ID. Bonferroni correction was used for these variables (number of comparisons = 8). Notably, the analysis in the present study differs from Barrett et al. (2010) in that we used nostalgia here as a categorical variable with two levels (nostalgia and control) rather than as a continuous variable.

Person-Level Measures

To assess the role of person-level measures on ratings of nostalgia, we mean-centered person-level scores across participants. In this

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analysis, we treated nostalgia rating as a continuous measure and ignored the categorical designation of condition. We then fit multilevel models, regressing nostalgia ratings onto the SNS, TIPI, BANPS, and PANAS-SF separately. Last, as done by Barrett et al. (2010), we fit two combined models: the first including SNS, TIPI, and PANAS and the second including SNS, BANPS, and PANAS. TIPI and BANPS thus were never included in the same model, as justified by Barrett et al. (2010), due to their high intercorrelation (Davis et al., 2003). We additionally tested whether the TIPI was intercorrelated with the BANPS in our sample with a series of Pearson correlations to confirm this choice (see Supplemental Figure S3). In all multilevel models, songs were clustered within participants, and a random intercept was included for participant ID.

Interaction of Context- and Person-Level Measures

To assess the interaction of context-level variables and person-level variables, we mean-centered all person-level scores across participants, as done in Barrett et al.'s (2010) study. We did not mean-center or standardize context-level variables within participants because some participants only had one measurement per condition. Given that the valence and arousal measures were all on the same scale, we decided this would additionally be the best choice for interpretability. We then estimated multilevel models, predicting felt valence (positive, negative, mixed) and arousal (high, low) in four separate models. First, we included the SNS, BANPS, and PANAS. Second, we include the SNS, TIPI, and PANAS. For each model set, we used Bonferroni correction for multiple comparisons (number of comparisons = 5). For each person-level measure, we included an interaction term of condition to assess whether person-level measures impacted the emotional experience of music listening in the nostalgia condition alone, or across all music. Songs were clustered within participants, and a random intercept was included for participant ID.

Trait Nostalgia and Personality

To assess the relationship between Trait Nostalgia (as measured with the SNS) and other personality factors, we repeated Barrett et al.'s (2010) analysis of regressing the SNS on BANPS dimensions and Big Five Inventory dimensions in separate linear regression models. BANPS and Big Five Inventory factors were mean-centered, and SNS was kept in raw form. All data and analysis code are available at https://osf.io/864nx/.

Results

After removing songs that were not properly matched in the Control Song Selection procedure, our final data set contained 1,117 nostalgic songs and 1,117 nonnostalgic control songs. Song pairs (nostalgia and control) were accurately matched across relevant musical features, and a more in-depth analysis of musical features across songs and conditions in this data set will be reported in a future publication. See Supplemental Table S1 for means and standard deviations of computer-derived musical features for nostalgia and control songs and Supplemental Figure S2 for a visualization of musical genre similarity across conditions.

Context-Level Differences Between Nostalgia and Control Songs

See Table 2 for means and standard deviations of context-level measures in each condition. The intraclass correlation coefficient (ICC) for nostalgia rating was ~0, indicating that nearly none of the variance for nostalgia ratings was at the individual participant level before including additional variables into the model. Nostalgic songs were rated as significantly more nostalgic than control songs, $\beta = 5.70$, $t(539.71) = 93.70$, $p_{adjusted} < .001$, $f^2 = 5.21$ (see Table 3). For felt valence and arousal, the ICCs were 0.025, 0.16, 0.09, and 0.22, indicating that 0.25%, 16%, 9%, and 22% of the variance for positivity, negativity, high arousal, and low arousal were at the individual participant level before including additional variables into the model. Nostalgia songs were also rated as significantly more positive valenced: $\beta = 3.94$, $t(1700) = 41.76$, $p_{adjusted} < .001$, $f^2 = 0.61$, and higher arousal: $\beta = 3.89$, $t(1681) = 39.27$, $p_{adjusted} < .001$, $f^2 = 0.49$, than control songs (see Figure 1; Tables 4 and 5).

For mixed valence, using the Griffin formula, the ICCs were 0.18 and 0.21 for the Griffin formula and MIN, respectively. Using the Griffin formula, control songs were significantly more mixed in valence than nostalgia songs, $\beta = -1.47$, $t(524) = -13.34$, $p_{adjusted} < .001$, $f^2 = 0.086$. Conversely, using MIN, nostalgia songs were significantly more mixed in valence than control songs, $\beta = 0.26$, $t(522) = 4.03$, $p_{adjusted} < .001$, $f^2 = 0.009$. See Table 6 for detailed multilevel model results.

Person-Level Measures

SNS score was a significant predictor of nostalgia rating, $\beta = 0.20$, $t(2232) = 3.16$, $p < .01$, $f^2 = 0.004$, such that participants with higher Trait Nostalgia found songs to be more nostalgic (Figure 2). No factors of the TIPI, PANAS, or BANPS were significant predictors of nostalgia rating ($ps > .05$) in individual models. In the combined model with TIPI, PANAS, and SNS, only the SNS significantly predicted nostalgia ratings, $\beta = 0.19$, $t(2225) = 2.77$, $p < .01$, $f^2 = 0.003$. In the combined model with BANPS, PANAS, and SNS, again only the SNS significantly predicted nostalgia ratings, $\beta = 0.20$, $t(2224) = 2.70$, $p < .01$, $f^2 = 0.003$. See Table 7 for additional model details.

Table 2
Means and Standard Deviations of Context-Level Measures Between Nostalgia and Control Songs

Variable	Control *M* (*SD*)	Nostalgia *M* (*SD*)
Nostalgia		
Nostalgia rating	2.31 (1.16)	8.02 (1.33)
Valence		
Positive valence	4.28 (2.85)	8.22 (2.12)
Negative valence	1.03 (1.94)	1.08 (1.98)
Mixed valence (Griffin formula)	−1.39 (2.14)	−2.86 (2.81)
Mixed valence (minimum function)	0.63 (1.15)	0.89 (1.59)
Arousal		
High arousal	2.37 (2.47)	6.26 (3.05)
Low arousal	2.50 (2.94)	2.58 (3.02)

Note. Valence and arousal metrics are on a scale of 0–10, where 10 indicates greater feelings of positive valence, negative valence, high arousal, or low arousal.

Table 3
Results of Multilevel Models, Nostalgia Rating Between Nostalgia and Control Songs

Predictor	Nostalgia rating				
	β	*SE*	*p* (adj.)	95% CI	f^2
(Intercept)	2.33	0.04	**<.001**	[2.25, 2.41]	
Condition [nostalgia]	5.70	0.06	**<.001**	[5.58, 5.82]	5.21
Random effects					
σ^2	1.11				
$\tau_{00\ id}$	0.33				
$\tau_{11\ id.conditionNostalgia}$	0.93				
$\rho_{01\ id}$	−0.62				
ICC	0.29				
N_{id}	582				
Observations	2,234				
Marginal R^2/conditional R^2	0.839/0.885				

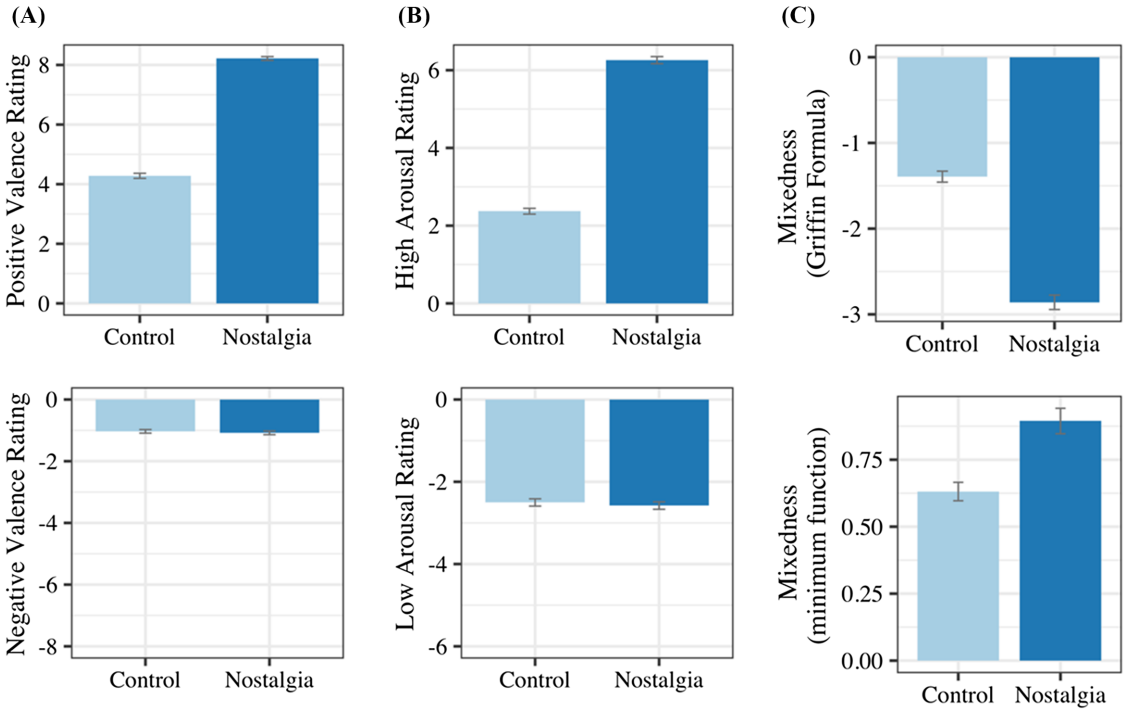
Note. Effect size is indicated with Cohen's f^2. Bold formatting indicates significance at $p < .05$. *SE* = standard error; *p*(adj.) = *p* value, adjusted using Bonferroni's correction; CI = confidence interval; id = participant level; ICC = intraclass correlation coefficient.

Interactions of Context-Level and Person-Level Measures

Valence

Negative Valence. First, we estimated a model that contained BANPS, PANAS-SF, and SNS, with condition as an interaction term for each predictor. We observed a significant main effect of PANAS-SF negative on felt negative valence, β = 0.27, *t*(1203) = 3.40, $p_{adjusted} < .01$, f^2 = ∼−0.00, where greater PANAS-SF negative scores were associated with greater felt negative valence across conditions. An interaction of PANAS-SF negative and song condition approached significance, β = −0.25, *t*(1673) = −2.57,

Figure 1
Context-Level Differences Between Nostalgia and Control Songs (With Songs Clustered Within Participants)



Note. Bars represent standard errors. (A) Positive and negative valence ratings for nostalgia and control songs. Negative valence ratings are multiplied by −1 for visualization purposes, where more negative values indicate greater feelings of negative valence. (B) High and low arousal ratings for nostalgia and control songs. Low arousal ratings are multiplied by −1 for visualization purposes, where more negative values indicate greater feelings of low arousal. (C) Mixed emotion calculations for nostalgia and control songs using the Griffin formula (upper pane) and the minimum function (lower pane). See the online article for the color version of this figure.

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Table 4
Results of Multilevel Models and Positive and Negative Valence Rating Between Nostalgia and Control Songs

	Positive valence					Negative valence				
Predictor	β	*SE*	*p*(adj.)	95% CI	f^2	β	*SE*	*p*(adj.)	95% CI	f^2
(Intercept)	4.28	0.08	**<.001**	[4.11, 4.44]		1.04	0.06	**<.001**	[0.92, 1.16]	
Condition [nostalgia]	3.94	0.09	**<.001**	[3.75, 4.12]	0.62	0.05	0.08	>1	[−0.10, 0.20]	∼0.00
Random effects										
σ^2	4.96					3.23				
τ_{00}	1.32_{id}					0.61_{id}				
ICC	0.21					0.16				
N	582_{id}					582_{id}				
Observations	2,234					2,234				
Marginal R^2/conditional R^2	0.381/0.512					0.000/0.158				

Note. Effect size is indicated with Cohen's f^2. Bold formatting indicates significance at $p < .05$. *SE* = standard error; *p*(adj.) = *p* value, adjusted using Bonferroni's correction; CI = confidence interval; id = participant level; ICC = intraclass correlation coefficient.

$p_{adjusted} = .05$, $f^2 = 0.002$, indicating that this effect was more pronounced in the control (β = 0.27) condition than the nostalgia condition (β = 0.02). There was a significant interaction effect of BANPS sadness and song condition on felt negative valence, β = 0.45, $t(1673) = 4.19$, $p_{adjusted} < .001$, $f^2 = 0.007$. This interaction indicated that while in the control condition greater BANPS sadness scores were associated with *less* negative valence (β = −0.13), in the nostalgia condition, it was associated with *greater* negative valence (β = 0.32).

Then, we fit a model that contained TIPI, PANAS, and SNS. In this model, we observed a main effect of PANAS-SF negative, β = 0.26, $t(546) = 3.36$, $p_{adjusted} < .01$, $f^2 = \sim -0.00$, where greater PANAS-SF negative scores were associated with greater felt negative valence across conditions. We observed a main effect of TIPI agreeableness, β = −0.21, $t(546) = -3.10$, $p_{adjusted} < .05$, $f^2 = \sim -0.00$, where greater agreeableness was associated with less felt negative valence across conditions. See Figure 3 for plots of significant predictors of negative valence. See Table 8 for model details.

Positive Valence. In the model that included BANPS, PANAS-SF, and SNS, we observed an interaction effect between SNS score and song condition, β = 0.27, $t(1694) = 2.60$, $p_{adjusted} < .05$, $f^2 = 0.002$, such that greater Trait Nostalgia scores were associated with greater felt positive valence, particularly in the nostalgia song condition. We additionally observed an interaction between BANPS anger and song condition, β = 0.33, $t(1694) = 3.28$, $p_{adjusted} < .01$, $f^2 = 0.004$, indicating that greater anger scores were associated with *less* positive valence in the control condition (β = −0.14) and *greater* positive valence in the nostalgia condition (β = 0.19).

In the model that included TIPI, PANAS, and SNS, there was a main effect of condition, β = 3.93, $t(1696) = 41.69$, $p_{adjusted} < .001$, $f^2 = 0.63$, such that positive valence was significantly higher in the nostalgia condition than the control condition (see Figure 4). See Table 9 for model details.

Mixed Valence. For mixed valence, we opted to use MIN, given that there was a main effect of song condition in the context-level models in the direction of our hypothesis and the fact that MIN is a better measure of uneven yet high-intensity mixed feeling. We estimated that these models assess whether person-level measures may moderate the relationship between nostalgia and mixed valence via MIN. In the model including BANPS, PANAS-SF, and SNS, we observed a significant interaction effect of PANAS-SF negative and song condition, β = −0.25, $t(1661) = -3.90$, $p_{adjusted} < .001$, $f^2 = 0.005$. This indicated that, in the nostalgia condition, greater PANAS-SF negative scores were associated with less mixedness

Table 5
Results of Multilevel Models and Arousal Rating Between Nostalgia and Control Songs

	High arousal					Low arousal				
Predictor	β	*SE*	*p*(adj.)	95% CI	f^2	β	*SE*	*p*(adj.)	95% CI	f^2
(Intercept)	2.40	0.09	**<.001**	[2.21, 2.59]		2.47	0.10	**<.001**	[2.27, 2.66]	
Condition [nostalgia]	3.89	0.10	**<.001**	[3.69, 4.08]	0.49	0.08	0.11	>1	[−0.14, 0.29]	∼0.00
Random effects										
σ^2	5.47					6.89				
τ_{00}	2.21_{id}					1.94_{id}				
ICC	0.29					0.22				
N	582_{id}					582_{id}				
Observations	2,234					2,234				
Marginal R^2/conditional R^2	0.330/0.522					0.000/0.220				

Note. Effect size is indicated with Cohen's f^2. Bold formatting indicates significance at $p < .05$. *SE* = standard error; *p*(adj.) = *p* value, adjusted using Bonferroni's correction; CI = confidence interval; id = participant level; ICC = intraclass correlation coefficient.

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Table 6
Results of Multilevel Models and Mixed Valence Rating Between Nostalgia and Control Songs

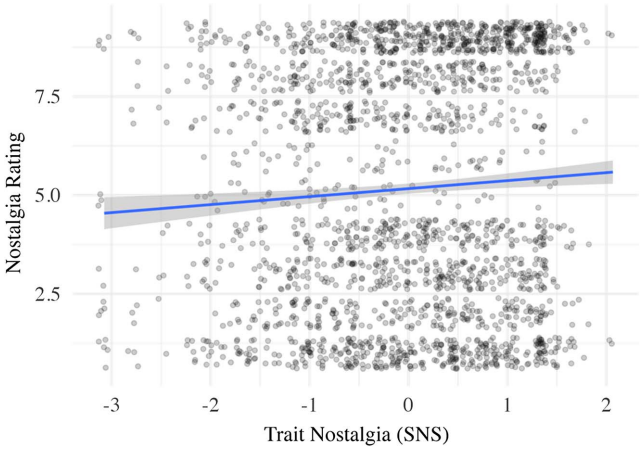
Predictor	Mixed valence (Griffin) β	*SE*	*p*(adj.)	95% CI	f^2	Mixed valence (MIN) β	*SE*	*p*(adj.)	95% CI	f^2
(Intercept)	−1.38	0.07	**<.001**	[−1.52, −1.23]		0.64	0.04	**<.001**	[0.56, 0.72]	
Condition [nostalgia]	−1.47	0.11	**<.001**	[−1.69, −1.26]	0.086	0.26	0.06	**<.001**	[0.13, 0.39]	0.009
Random effects										
σ^2	3.93					1.14				
τ_{00}	1.08_{id}					0.36_{id}				
τ_{11}	$2.74_{id.conditionNostalgia}$					$1.13_{id.conditionNostalgia}$				
ρ_{01}	-0.07_{id}					-0.18_{id}				
ICC	0.37					0.42				
N	582_{id}					582_{id}				
Observations	2,234					2,234				
Marginal R^2/ conditional R^2	0.080/0.423					0.009/0.421				

Note. Effect size is indicated with Cohen's f^2. Bold formatting indicates significance at $p < .05$. *SE* = standard error; *p*(adj.) = *p* value, adjusted using Bonferroni's correction; CI = confidence interval; MIN = minimum function; id = participant level; ICC = intraclass correlation coefficient.

(β = −2.29), but in the control condition, greater PANAS-SF negative scores were associated with more mixedness (β = 0.24). We additionally observed an interaction of BANPS sadness and song condition, β = 0.31, $t(1661) = 4.30$, $p_{adjusted} < .001$, $f^2 = 0.006$. In this case, greater sadness scores were associated with more mixedness in the nostalgia condition (β = 0.25) and less mixedness in the control condition (β = −0.64).

In the model that included TIPI, PANAS, and SNS, we observed a significant interaction effect of PANAS-SF negative and song condition, β = −0.22, $t(1663) = -3.43$, $p_{adjusted} < .01$, $f^2 = 0.003$, indicating that greater negative scores were associated with more mixedness, particularly in the control condition (β = 0.25; nostalgia β = 0.03; see Figure 5). See Table 10 for model details.

Figure 2
Trait Nostalgia Predicting Nostalgia Rating of Songs Across Conditions



Note. Trait Nostalgia is mean-centered. The shaded band represents 95% confidence interval. Greater nostalgia scores indicate increased feelings of nostalgia while listening. SNS = Southampton Nostalgia Scale. See the online article for the color version of this figure.

Arousal

High Arousal. In the model including BANPS, PANAS-SF, and SNS, we observed an interaction effect between SNS score and song condition, β = 0.37, $t(1675) = 3.44$, $p_{adjusted} < .01$, $f^2 = 0.004$, indicating that higher Trait Nostalgia was associated with higher arousal, particularly in the nostalgia condition (β = 0.49). We observed an interaction effect of PANAS-SF positive and song condition, β = −0.35, $t(1675) = -2.63$, $p_{adjusted} < .05$, $f^2 = 0.002$, indicating that higher PANAS-SF positive scores were associated with higher arousal but that this relationship was stronger in the control condition (β = 0.49) than the nostalgia condition (β = 0.14). We additionally observed an interaction effect between BANPS care and song condition, β = 0.36, $t(1675) = -3.03$, $p_{adjusted} < .05$, $f^2 = \sim -0.00$. This interaction indicated that greater care scores were associated with higher arousal in the nostalgia condition (β = 0.22) but lower arousal in the control condition (β = −0.37). Last, there was an interaction effect between BANPS anger and song condition, β = 0.41, $t(1675) = 3.86$, $p_{adjusted} < .001$, $f^2 = 0.005$, such that greater anger predicted higher arousal in the nostalgia condition (β = 0.27), but lower arousal in the control condition (β = −0.14).

In the model including TIPI, PANAS, and SNS, we observed an interaction effect between SNS score and condition, β = 0.35, $t(1678) = 3.37$, $p_{adjusted} < .05$, $f^2 = 0.004$, indicating that higher Trait Nostalgia was associated with higher arousal, particularly in the nostalgia condition (β = 0.47). Last, we observed a main effect of PANAS-SF positive, β = 0.47, $t(1061) = 3.80$, $p_{adjusted} < .001$, $f^2 = \sim 0.00$, indicating that greater positive scores were associated with higher arousal (see Figure 6). See Table 11 for model details.

Low Arousal. No significant effects were found in the BANPS model. In the model including TIPI, PANAS, and SNS, we observed a significant main effect of SNS on felt low arousal, β = −0.30, $t(552) = -2.85$, $p_{adjusted} < .05$, $f^2 = \sim 0.00$, such that greater Trait Nostalgia was associated with less low arousal across conditions (see Figure 7). See Table 12 for model details.

Personality and Trait Nostalgia

We conducted two standard linear regressions. In the first, we regressed SNS onto the six BANPS factors. Play, β = 0.32,

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Table 7
Results of Combined Multilevel Model and Person-Level Measures Predicting Nostalgia Rating

	Nostalgia rating									
Predictor	β	*SE*	*p*(adj.)	95% CI	f^2	β	*SE*	*p*	95% CI	f^2
(Intercept)	5.17	0.07	**<.001**	[5.04, 5.29]		5.17	0.07	**<.001**	[2.88, 5.54]	
SNS score	0.19	0.07	**.006**	[0.06, 0.33]	0.003	0.20	0.07	**.007**	[0.06, 0.35]	0.003
PANAS-SF positive	0.01	0.09	.911	[−0.16, 0.18]	∼0.00	0.03	0.09	.694	[−0.02, 0.02]	∼0.00
PANAS-SF negative	−0.01	0.08	.925	[−0.17, 0.15]	∼0.00	−0.01	0.08	.932	[−0.02, 0.02]	∼0.00
TIPI extraversion	0.04	0.08	.622	[−0.11, 0.19]	∼0.00					
TIPI agreeable	0.04	0.07	.560	[−0.10, 0.18]	∼0.00					
TIPI conscientious	0.05	0.08	.551	[−0.11, 0.20]	∼0.00					
TIPI stability	−0.06	0.09	.529	[−0.23, 0.12]	∼0.00					
TIPI openness	−0.06	0.07	.395	[−0.20, 0.08]	∼0.00					
BANPS play						0.01	0.08	.934	[−0.21, 0.23]	∼0.00
BANPS anger						0.03	0.07	.718	[−0.15, 0.22]	∼0.00
BANPS seek						−0.03	0.07	.699	[−0.26, 0.18]	∼0.00
BANPS care						−0.01	0.08	.879	[−0.19, 0.16]	∼0.00
BANPS fear						−0.02	0.08	.846	[−0.29, 0.24]	∼0.00
BANPS sadness						0.02	0.09	.828	[−0.17, 0.21]	∼0.00
Random effects										
σ^2	9.69					9.70				
τ_{00}	0.00_{id}					0.00_{id}				
N	582_{id}					582_{id}				
Observations	2,234					2,234				
Marginal R^2/conditional R^2	0.005/NA					0.005/NA				

Note. Effect size is indicated with Cohen's f^2. Bold formatting indicates significance at $p < .05$. *SE* = standard error; *p*(adj.) = *p* value, adjusted using Bonferroni's correction; CI = confidence interval; SNS = Southampton Nostalgia Scale; PANAS-SF = Positive and Negative Affect Schedule, Short Form; TIPI = Ten-Item Personality Inventory; BANPS = Brief Affective Neuroscience Personality Scales; id = participant level; NA = not applicable.

$t(575) = 7.35$, $p < .001$, $f^2 = 0.093$, and care, $\beta = 0.12$, $t(575) = 2.90$, $p < .01$, $f^2 = 0.014$, were both significant positive predictors of Trait Nostalgia (see Figure 8). See Table 13 for additional model details.

In the second model, we regressed SNS onto the five factors from the TIPI. This model revealed that extraversion, $\beta = 0.20$, $t(576) = 4.78$, $p < .001$, $f^2 = 0.039$, and agreeableness, $\beta = 0.14$, $t(576) = 3.24$, $p < .01$, $f^2 = 0.018$, were significant positive predictors of Trait Nostalgia, such that the participants who scored higher in extraversion and agreeableness were higher in Trait Nostalgia. Stability, $\beta = -0.11$, $t(576) = -2.49$, $p < .05$, $f^2 = 0.011$, was a significant negative predictor of Trait Nostalgia, such that the participants who were higher in stability were lower in Trait Nostalgia.

Discussion

This study provides a conceptual replication and extension of Barrett et al.'s (2010) investigation of music-evoked nostalgia. We collected responses to self-selected nostalgia-evoking songs and nonnostalgic control songs from 582 participants across the United States. We explored context- and person-level predictors of music-evoked nostalgia and its associated affective experience. We additionally examined the relationship between person-level variables and trait-level Trait Nostalgia. Results demonstrated that both context-level factors, including the felt arousal and valence of a song, and person-level factors, including trait-level Trait Nostalgia, predicted music-evoked nostalgia. We observed that context- and person-level variables interacted to produce differing affective experiences, including variation in how positively or negatively nostalgia was felt. Overall, the results of the present study are largely consistent with Barrett et al. (2010), conceptually replicating the findings in a larger and more diverse sample. Results suggest that music-evoked nostalgia is a complex human emotion with a distinct affective profile from nonnostalgic feelings elicited by familiar music and a subjective experience that may vary on individual characteristics of the listener.

Self-Report as a Stimulus Selection Method

To begin, we observed that self-report (i.e., directly *asking* participants to list three songs that they knew would make them feel nostalgia) was a highly effective method of generating personalized nostalgic stimuli for this study. All nostalgic songs were rated as very nostalgic, with an average rating of 8.02 out of 9. This method achieved our goal of examining music-evoked nostalgia while accounting for the broad range of music-listening preferences and experiences, through *personalization*. Our method of selecting paired control songs was also effective; control songs were rated as significantly less nostalgic than self-selected nostalgia songs (with an average rating of 2.3 out of 9). These songs were familiar, and matched based on acoustic and musical features (reported in a future publication), yet did not carry nostalgic value. We contend that this method of stimulus selection may be an effective way for future work to study music-evoked nostalgia or music-evoked autobiographical memories.

Nostalgia and Context-Level Constructs

In this study, we found that context-level constructs including valence and arousal differed between nostalgia and control songs. While the methods used to assess this were slightly different

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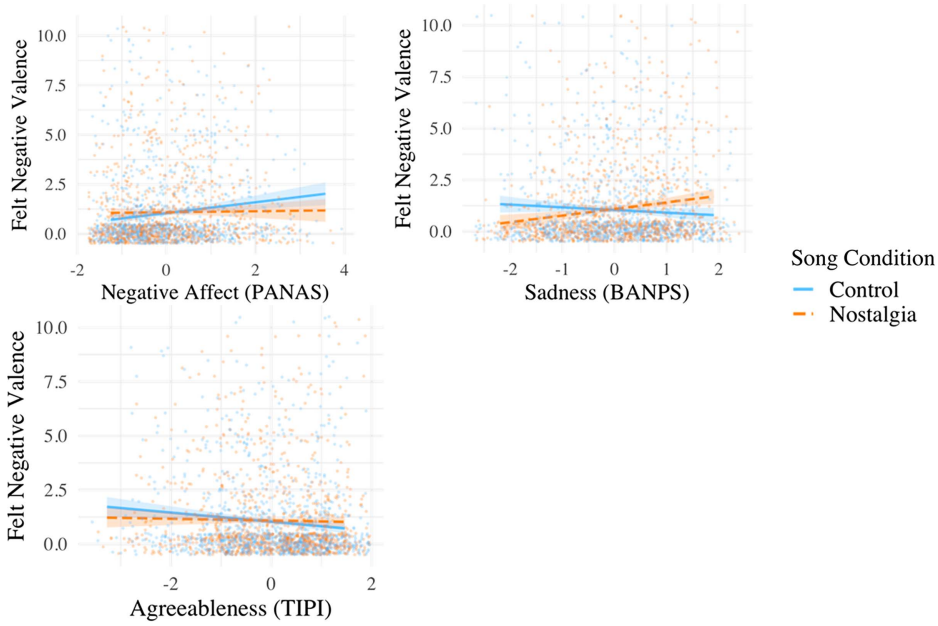
Figure 3

Person-Level Predictors of Negative Felt Valence in Response to Nostalgia and Control Songs



Note. Negative affect and BANPS sadness plots are depicted using the model with BANPS predictors. TIPI agreeableness plot is depicted using the model with TIPI predictors. Predictor variables are mean-centered. Shaded bands represent 95% confidence intervals. Greater negative valence scores indicate increased feelings of negative valence while listening. PANAS = Positive and Negative Affect Schedule; BANPS = Brief Affective Neuroscience Personality Scales; TIPI = Ten-Item Personality Inventory. See the online article for the color version of this figure.

(i.e., predicting a binary vs. a continuous measure of nostalgia, using discrete emotions vs. a bivalent scale), these results largely replicate Barrett et al.'s (2010) work. In our study, participants felt more positive and higher energy while listening to nostalgic songs than while listening to control songs. In relation to arousal, our findings replicate that of Barrett et al. (2010), in which arousal positively predicted nostalgia rating, indicating that more nostalgic songs were experienced as higher arousal. Here, we found that arousal was higher in nostalgic than control songs, indicating that music that evokes nostalgia also evokes a high-energy profile of feeling.

In Barrett et al. (2010), the participants endorsed a greater number of different positive emotions while listening to nostalgic music (e.g., love, longing, joy) compared with nonnostalgic, nonautobiographical music. They additionally found that the participants endorsed one particular negative emotion (sadness) more while listening to nostalgic versus nonnostalgic music. We did not find in this study that negative valence was significantly higher for nostalgic versus control songs. This discrepancy might be due to the appraisals of specific emotions as they are reduced to valence and arousal dimensions; perhaps some participants felt sad as a discrete emotion but did not experience or report sadness as a negatively valenced emotion. This "pleasurable sadness" is not an uncommon experience when listening to music (for review, see Sachs et al., 2015) and may account for this difference in findings. Additionally, because the participants self-selected their nostalgic pieces of music and the instructions included the word "pleasant," it is likely that they simply found the songs to be pleasant to listen to and thus rated them as higher valenced.

Relatedly, we explored the concept of co-occurring positive and negative valence using two different metrics of mixed feelings. Barrett et al. (2010) observed that nostalgia ratings were positively predicted by the incidence of co-occurring positive and negative discreet emotions. Here, we observed that nostalgic songs evoked *more* mixed valence in comparison with control songs according to MIN (Schimmack, 2001) but *less* mixed valence according to the Griffin formula (Thompson et al., 1995). Observed effects of mixedness in this study are somewhat limited, however, due to the nature in which nostalgia and nostalgia-evoking song were defined. The definition of "nostalgia-evoking song" contained connotations of positivity which, we observed during pilot testing of the initial survey, was necessary to convey the task instructions effectively. Without this additional clarification, the participants often reported memory-evoking songs that they did not "long" for but that were evocative of negative or traumatic memories. However, this may have predisposed participants to report songs and therefore subjective feeling responses that were more positive than mixed. Nonetheless, the inconsistency in the two mixedness metrics suggests a need for further exploration. The minimum formula provides an account of the *intensity* of a mixed emotion, where mixedness is calculated as the degree to which a weaker affect conflicts with a stronger affect. The Griffin formula provides an account of the intensity in combination

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Table 8

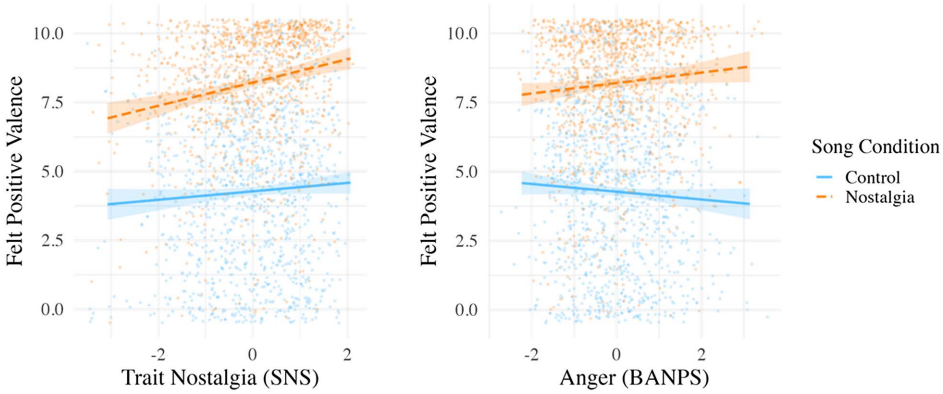
Results of Multilevel Models and Interactions of Context-Level and Person-Level Measures: Negative Valence Ratings

Predictor	Negative valence									
	β	*SE*	*p*(adj.)	95% CI	f^2	β	*SE*	*p*(adj.)	95% CI	f^2
(Intercept)	1.04	0.06	**<.001**	[1.72, 1.84]		1.04	0.06	**<.001**	[0.92, 1.17]	
SNS score	−0.08	0.07	>1	[−0.21, 0.05]		−0.08	0.07	>1	[−0.21, 0.06]	~0.00
Condition [nostalgia]	0.05	0.08	>1	[−0.09, 0.20]	~0.00	0.04	0.08	>1	[−0.11, 0.19]	~0.00
PANAS-SF positive	0.08	0.08	>1	[−0.09, 0.24]	~−0.00	0.12	0.08	.78	[−0.04, 0.29]	~0.00
PANAS-SF negative	0.26	0.08	**.005**	[0.11, 0.42]	~−0.00	0.27	0.08	**.003**	[0.17, 0.43]	~−0.00
TIPI extraversion	0.16	0.07	.155	[0.01, 0.30]	~−0.00					
TIPI agreeable	−0.21	0.07	**.01**	[−0.34, −0.08]	~−0.00					
TIPI conscientious	0.04	0.07	>1	[−0.10, 0.18]	~−0.00					
TIPI stability	0.22	0.08	.05	[0.05, 0.39]	~−0.00					
TIPI openness	0.02	0.07	>1	[−0.12, 0.15]	~−0.00					
SNS Score × Condition [Nostalgia]	0.03	0.08	>1	[−0.12, 0.19]	~0.00	−0.01	0.08	>1	[−0.17, 0.15]	−0.00
Condition [Nostalgia] × PANAS-SF Positive	−0.15	0.10	.72	[−0.35, 0.05]	0.001	−0.13	0.10	.92	[−0.33,−0.43]	0.007
Condition [Nostalgia] × PANAS-SF Negative	−0.18	0.09	.305	[−0.36, 0.01]	0.01	−0.25	0.10	.05	[−0.43, −0.06]	0.002
Condition [Nostalgia] × TIPI Extraversion	−0.07	0.09	>1	[−0.24, 0.10]	~0.00					
Condition [Nostalgia] × TIPI Agreeable	0.17	0.08	.205	[0.01, 0.33]	0.001					
Condition [Nostalgia] × TIPI Conscientious	−0.21	0.09	.09	[−0.38, −0.04]	0.002					
Condition [Nostalgia] × TIPI Stability	−0.25	0.10	.08	[−0.45, −0.05]	0.002					
Condition [Nostalgia] × TIPI Openness	0.10	0.08	.217	[−0.06, 0.26]	0.001					
BANPS play						0.03	0.08	>1	[−0.12, 0.18]	~0.00
BANPS anger						−0.03	0.07	>1	[−0.16, 0.10]	~−0.00
BANPS seek						0.05	0.07	>1	[−0.09, 0.19]	~0.00
BANPS care						−0.04	0.08	>1	[−0.18, 0.11]	~0.00
BANPS fear						−0.06	0.08	>1	[−0.22, 0.10]	~−0.00
BANPS sadness						−0.13	0.09	.755	[0.31, 0.05]	~0.00
Condition [Nostalgia] × BANPS Play						0.06	0.10	>1	[−0.12, 0.25]	~0.00
Condition [Nostalgia] × BANPS Anger						−0.02	0.08	>1	[−0.18, 0.13]	~−0.00
Condition [Nostalgia] × BANPS Seek						−0.02	0.08	>1	[−0.19, −0.14]	~0.00
Condition [Nostalgia] × BANPS Care						0.03	0.09	>1	[−0.15, 0.20]	~0.00
Condition [Nostalgia] × BANPS Fear						0.04	0.10	>1	[−0.15, 0.23]	~−0.00
Condition [Nostalgia] × BANPS sadness						0.45	0.11	**<.001**	[0.24, 0.66]	0.007
Random effects										
σ^2	3.19					3.19				
τ_{00}	0.57_{id}					0.60_{id}				
ICC	0.15					0.16				
N	582_{id}					582_{id}				
Observations	2,234					2,234				
Marginal R^2/conditional R^2	0.028/0.176					0.022/0.176				

Note. Effect size is indicated with Cohen's f^2. Bold formatting indicates significance at $p < .05$. *SE* = standard error; *p*(adj.) = *p* value, adjusted using Bonferroni's correction; CI = confidence interval; SNS = Southampton Nostalgia Scale; PANAS-SF = Positive and Negative Affect Schedule, Short Form; TIPI = Ten-Item Personality Inventory; BANPS = Brief Affective Neuroscience Personality Scales; id = participant level; ICC = intraclass correlation coefficient.

Figure 4

Person-Level Predictors of Positive Felt Valence in Response to Nostalgia and Control Songs



Note. Both plots are depicted using the model that included BANPS. Predictors are mean-centered. Shaded bands represent 95% confidence intervals. Greater positive valence scores indicate increased feelings of positive valence while listening. SNS = Southampton Nostalgia Scale; BANPS = Brief Affective Neuroscience Personality Scales. See the online article for the color version of this figure.

with the *similarity* of a mixed emotion, such that highly intense mixed feelings are discounted by the degree of dissimilarity (the difference between positive and negative). When the difference between positive and negative valence is 0 (a perfectly even affect), the Griffin and MIN functions equate. Yet, in situations with less balance, the Griffin mixedness is much lower than MIN mixedness, making the Griffin formula less sensitive to incidences of unevenly mixed emotions. In this study, nostalgic songs were rated as highly positive, reaching nearly ceiling. Thus, to achieve a high level of mixedness, according to the Griffin formula, participants would have had to rate negative valence *as* or *nearly as* intense as positive valence, which is extremely unlikely in situations of such high intensity (Larsen et al., 2017). Instead, we observe that, in comparison with control songs, nostalgic songs elicit higher intensity of co-occurring positive and negative feelings and accompanying lower balance of such feelings. Here, the co-occurrence of positive and negative valence is marked by a high intensity positive affect in combination with a low intensity (yet, nonzero) negative affect. Taken together, the context-level findings of this study paint an affective profile of the music-evoked nostalgic experience: a high arousal, unevenly mixed feeling that contains more positive than negative valence.

Nostalgia and Person-Level Constructs

Among person-level variables, trait-level Trait Nostalgia was the only significant predictor of nostalgia rating. Individuals who were more prone to experiencing nostalgia experienced higher levels of nostalgia when listening to music. We did not replicate Barrett et al.'s (2010) additional person-level findings, in which BANPS play and PANAS negative affect predicted nostalgia rating in individual models. This might be explained by the larger range of variance in nostalgia ratings observed in Barrett et al.'s (2010) study. By design, our study had a smaller range of nostalgia rating values, constituting the two song conditions. Yet, even in Barrett et al.'s (2010) study, when considering all person-level factors in combined models, Trait Nostalgia was by far the most consistent and influential factor contributing to the nostalgic experience. Our results corroborate Barrett et al.'s (2010) study, suggesting that Trait Nostalgia is the most significant person-level variable contributing to the music-evoked nostalgic experience.

Interactions Between Context- and Person-Level Constructs

While Trait Nostalgia was the only person-level predictor of nostalgia rating, we did observe the contribution of several other person-level variables when considered in combination with context-level factors. We found support for the idea that the affective experience of music-evoked nostalgia may differ depending on a listener's personality. We observed two general groupings of context-level effects that appeared to be influenced by person-level constructs: (a) an *exaggeration* of valence and arousal markers and (b) *recategorization* of the valence profile of music-evoked nostalgia.

In the first, we observed that both individuals that were higher in BANPS anger and Trait Nostalgia had an exaggeration of valence and arousal differences between nostalgia and control songs as observed in context-level-only models. That is, anger and Trait Nostalgia were associated with higher arousal and more positive valence in nostalgic music, whereas these relationships were flatter (Trait Nostalgia) or negative (anger) for control music. The Trait Nostalgia finding aligns with Barrett et al.'s (2010) finding, in which they observed tentative support for Trait Nostalgia to increase the potency of context-level effects. These findings also support the idea of a "Trait Nostalgia feedback loop" in which certain individuals experience more reward from nostalgia, incentivizing them to engage in repeated nostalgia-seeking behaviors. Interestingly, Trait Nostalgia did not predict the experience of mixed feelings while listening. This may indicate that experiencing mixed feelings is not necessarily part of the rewarding feedback loop that causes individuals to be drawn to nostalgic stimuli. The parallel experience reported

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Table 9

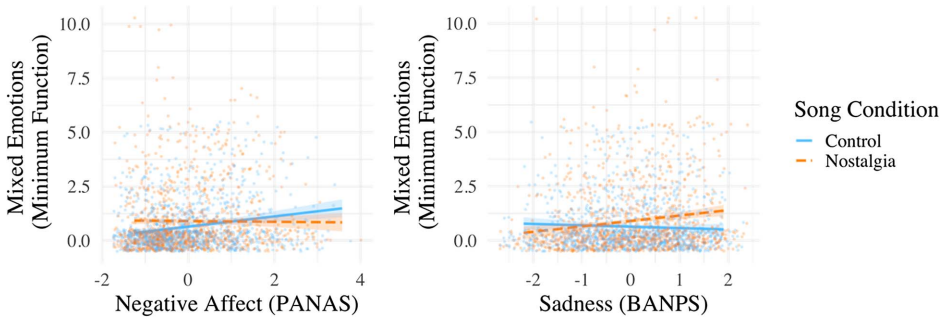
Results of Multilevel Models and Interactions of Context-Level and Person-Level Measures: Positive Valence Ratings

Predictor	Positive valence									
	β	*SE*	*p*(adj.)	95% CI	f^2	β	*SE*	*p*(adj.)	95% CI	f^2
(Intercept)	4.29	0.08	**<.001**	[4.13, 4.45]		4.28	0.08	**<.001**	[4.13, 4.44]	
SNS score	0.21	0.09	.074	[0.04, 0.38]	~0.00	0.15	0.09	.444	[−0.02, 0.33]	~−0.00
condition [nostalgia]	3.93	0.09	**<.001**	[3.74, 4.11]	0.63	3.94	0.09	**<.001**	[3.75, 4.12]	0.63
PANAS-SF positive	0.27	0.11	.07	[0.06, 0.48]	~−0.00	0.16	0.11	.73	[−0.05, 0.37]	~−0.00
PANAS-SF negative	0.17	0.10	.495	[−0.03, 0.36]	~0.00	0.23	0.10	.134	[0.03, 0.43]	~−0.00
TIPI extraversion	−0.12	0.09	1.	[−0.03, 0.36]	~0.00					
TIPI agreeable	0.22	0.09	.07	[0.05, 0.39]	~0.00					
TIPI conscientious	0.00	0.10	>1	[−0.18, 0.19]	~0.00					
TIPI stability	−0.05	0.11	>1	[−0.27, 0.16]	~0.00					
TIPI openness	−0.02	0.09	>1	[−0.19, 0.15]	~0.00					
SNS Score × Condition [Nostalgia]	0.19	0.10	.29	[−0.01, 0.38]	0.001	0.27	0.10	**.046**	[0.07, 0.47]	0.002
Condition [Nostalgia] × PANAS-SF Positive	−0.13	0.13	>1	[−0.38, 0.12]	~−0.00	−0.07	0.13	>1	[−0.32, 0.17]	~−0.00
Condition [Nostalgia] × PANAS-SF Negative	−0.25	0.12	.17	[−0.48, −0.02]	0.001	−0.22	0.12	.31	[−0.46, 0.01]	0.001
Condition [Nostalgia] × TIPI Extraversion	0.17	0.11	.625	[−0.05, 0.38]	0.001					
Condition [Nostalgia] × TIPI Agreeable	−0.11	0.10	>1	[−0.31, 0.09]	~0.00					
Condition [Nostalgia] × TIPI Conscientious	0.13	0.11	>1	[−0.08, 0.35]	~0.00					
Condition [Nostalgia] × TIPI Stability	−0.06	0.13	>1	[−0.31, 0.19]	~−0.00					
Condition [Nostalgia] × TIPI Openness	−0.06	0.10	>1	[−0.26, 0.14]	~−0.00					
BANPS play						0.23	0.10	.124	[0.03 0.43]	~−0.00
BANPS anger						−0.14	0.09	.54	[−0.31, 0.03]	~−.00
BANPS seek						−0.09	0.09	>1	[−0.27, 0.08]	~−0.00
BANPS care						0.05	0.10	>1	[−0.14, 0.24]	~−0.00
BANPS fear						0.01	0.10	>1	[−0.20, 0.21]	~−0.00
BANPS sadness						−0.03	0.12	>1	[−0.26, 0.19]	~−0.00
Condition [Nostalgia] × BANPS Play						−0.20	0.12	.445	[−0.43, 0.03]	0.001
Condition [Nostalgia] × BANPS Anger						0.33	0.10	**.005**	[0.13, 0.53]	0.004
Condition [Nostalgia] × BANPS Seek						0.12	0.10	>1	[−0.08, 0.32]	~0.00
Condition [Nostalgia] × BANPS Care						−0.03	0.11	>1	[−0.25, 0.19]	~−0.00
Condition [Nostalgia] × BANPS Fear						−0.14	0.12	>1	[−0.37, 0.10]	~−0.00
Condition [Nostalgia] × BANPS Sadness						−0.13	0.13	>1	[−0.39, 0.13]	~0.00
Random effects										
σ^2	4.94					4.92				
τ_{00}	1.16_{id}					1.17_{id}				
ICC	0.19					0.19				
N	582_{id}					582_{id}				
Observations	2,234					2,234				
Marginal R^2/conditional R^2	0.403/0.517					0.405/0.519				

Note. Effect size is indicated with Cohen's f^2. Bold formatting indicates significance at $p < .05$. *SE* = standard error; *p*(adj.) = *p* value, adjusted using Bonferroni's correction; CI = confidence interval; SNS = Southampton Nostalgia Scale; PANAS-SF = Positive and Negative Affect Schedule, Short Form; TIPI = Ten-Item Personality Inventory; BANPS = Brief Affective Neuroscience Personality Scales; id = participant level; ICC = intraclass correlation coefficient.

Figure 5

Person-Level Predictors of Mixed Valence (Using the Minimum Function) During Nostalgia or Control Music Conditions



Note. Both plots are depicted using the model with BANPS. Predictors are mean-centered. Shaded bands represent 95% confidence intervals. PANAS = Positive and Negative Affect Schedule; BANPS = Brief Affective Neuroscience Personality Scales. See the online article for the color version of this figure.

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by individuals higher on BANPS anger may reflect an adaptive function of music-evoked nostalgia, in which individuals more prone to feelings of anger may turn to nostalgic music to effectively regulate their emotions. In line with the Regulatory Model of Nostalgia (Wildschut & Sedikides, 2023), individuals with higher anger may experience greater negative affect and then turn to nostalgia due to its highly positive and highly arousing feeling to help balance and maintain homeostasis. Previous work has shown that music-evoked nostalgia may help regulate emotions by allowing a listener to approach difficult situations (Gibbs & Egermann, 2021).

We additionally observed increased arousal felt during nostalgia-evoking songs, with no marked changes in valence. This affective profile was associated with increased BANPS care, indicating that individuals higher in caring had an exaggerated experience of the arousal increases associated with nostalgia in music. The BANPS care dimension is related to prosocial behaviors (Barrett et al., 2013). This finding may suggest that individuals more attuned to these behaviors may also experience the highly social emotion of nostalgia to be more emotionally activated.

Conversely, we observed that some individuals experienced music-evoked nostalgia as an opposite profile of valence, specifically, one that was more *negative* in nostalgic music than control music. Individuals who scored higher on BANPS sadness reported greater feelings of negative valence when listening to nostalgic songs and less feelings of negative valence when listening to control songs. This was accompanied by increased mixed valence. Thus, in contrast to differences between nostalgia and control across participants, nostalgic songs for these individuals still evoked more mixedness than control songs, but this mixedness was skewed negatively instead of positively. Garrido (2018) observed a similar finding in their study exploring the role of depression in the affective experience of nostalgia; while most participants experienced positive affect, individuals with depressive tendencies (i.e., ruminative thinking) experienced greater *negative* affect after listening to nostalgic music (Garrido, 2018). This may indicate that participants who have greater sadness are utilizing nostalgic music to discharge negative emotions (Saarikallio et al., 2013, 2021; Shifriss et al., 2015), intensifying the habitual negative thought patterns experienced by these individuals. As argued by Garrido (2018), this emphasizes that nostalgia may not always be an adaptive coping mechanism. Instead, the adaptive function of nostalgia appears to vary across individual personalities. Future work exploring the relationship between the affective profile of music-evoked nostalgia and functions of music emotion regulation (e.g., using the Music Mood Regulation Scale; Saarikallio, 2012) could elucidate this further.

Last, we observed several interactions involving PANAS-SF positive and negative affect. We interpret PANAS-SF findings in this study with caution; given that participants completed the PANAS-SF after listening to all songs in this study, we cannot interpret PANAS-SF findings in the same manner as done by Barrett et al. (2010). Their study used PANAS to indicate the affective state of the participant before listening. Here, PANAS-SF scores can only indicate affective state *after* listening to both nostalgic and nonnostalgic music. In this vein, our findings indicate that individuals who found nostalgic music to be negative and control music to be mixed with a negative skew also reported greater negative affect at the end of the study. Additionally, individuals who found all music, but particularly control music, to be higher in arousal reported greater positive affect at the end of the study. As with all observations in this study, we cannot infer a causal relationship. Yet, these findings do align with previous work indicating that the valence felt after a nostalgic experience is largely congruent with the valence of the nostalgic trigger (Newman & Sachs, 2023). Overall, the interactive effects of person and context-level factors on the nostalgic experience highlight the importance of individual differences when considering the feeling experience of an emotion like nostalgia.

Predictors of Trait Nostalgia

Our final analysis investigated the accompanying person-level profile of Trait Nostalgia. We replicated Barrett et al.'s (2010) finding that stability (the direct inverse of neuroticism) was negatively correlated with Trait Nostalgia. This additionally aligns with findings from other research groups published since Barrett et al.'s (2010) original article (Newman et al., 2020;

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Table 10

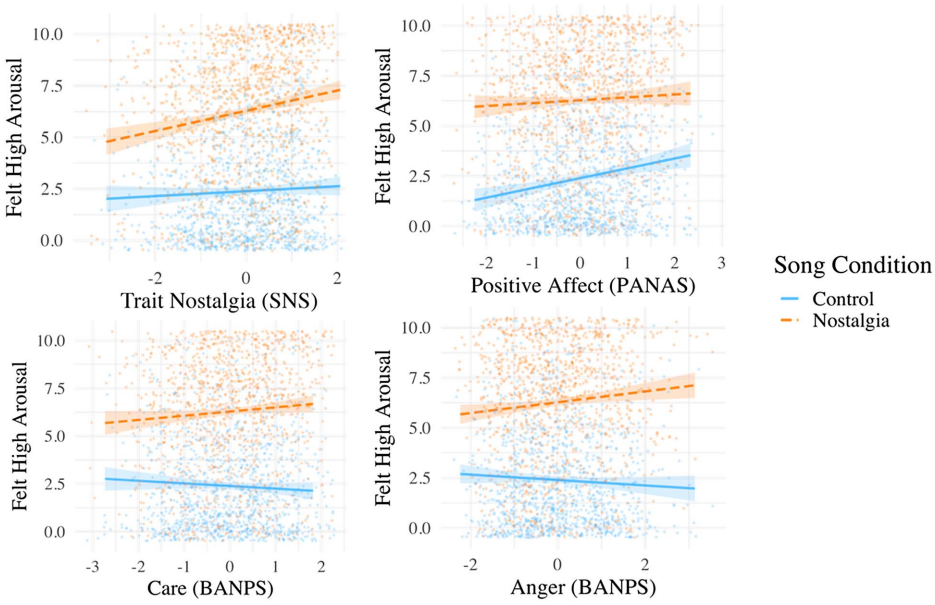
Results of Multilevel Models and Interactions of Context-Level and Person-Level Measures: Mixed Valence Ratings (Using the Minimum Function)

Predictor	Mixed valence (MIN)									
	β	*SE*	*p*(adj.)	95% CI	f^2	β	*SE*	*p*(adj.)	95% CI	f^2
(Intercept)	0.64	0.05	**<.001**	[0.55, 0.73]		0.64	0.05	**<.001**	[0.55, 0.73]	
SNS score	−0.06	0.05	>1	[−0.15, 0.04]	~0.00	−0.06	0.05	>1	[−0.15, 0.04]	~0.00
Condition [nostalgia]	0.26	0.05	**<.001**	[0.16, 0.37]	0.009	0.26	0.05	**<.001**	[0.16, 0.36]	0.009
PANAS-SF positive	0.03	0.06	>1	[−0.09, 0.15]	~0.00	0.07	0.06	>1	[−0.05, 0.19]	~0.00
PANAS-SF negative	0.25	0.06	**<.001**	[0.14, 0.37]	~−0.00	0.24	0.06	**<.001**	[0.12, 0.35]	~−0.00
TIPI extraversion	0.10	0.05	.235	[0.00, 0.21]	~0.00					
TIPI agreeable	−0.05	0.05	>1	[−0.15, 0.04]	~0.00					
TIPI conscientious	0.00	0.05	>1	[−0.10, 0.11]	~−0.00					
TIPI stability	0.12	0.06	.225	[0.00, 0.24]	~−0.00					
TIPI openness	0.00	0.05	>1	[−0.10, 0.10]	~−0.00					
SNS Score × Condition [Nostalgia]	0.06	0.05	>1	[−0.04, 0.17]	~0.00	0.03	0.06	>1	[−0.08, 0.14]	~0.00
Condition [Nostalgia] × PANAS-SF Positive	−0.06	0.07	>1	[−0.20, 0.07]	~0.00	−0.04	0.07	>1	[−0.17, 0.10]	~0.00
Condition [Nostalgia] × PANAS-SF Negative	−0.22	0.06	**.003**	[−0.35, −0.09]	0.004	−0.25	0.07	**<.001**	[−0.38, −0.12]	0.005
Condition [Nostalgia] × TIPI Extraversion	−0.03	0.06	>1	[−0.15, 0.08]	~0.00					
Condition [Nostalgia] × TIPI Agreeable	0.02	0.06	>1	[−0.09, 0.13]	~0.00					
Condition [Nostalgia] × TIPI Conscientious	−0.15	0.06	.06	[−0.27, −0.03]	0.002					
Condition [Nostalgia] × TIPI Stability	−0.14	0.07	.25	[−0.27, −0.00]	0.001					
Condition [Nostalgia] × TIPI Openness	0.06	0.06	>1	[−0.05, 0.17]	~−0.00					
BANPS play						0.01	0.06	>1	[−0.10, 0.12]	~0.00
BANPS anger						−0.02	0.05	>1	[−0.11, 0.08]	~0.00
BANPS seek						0.01	0.05	>1	[−0.09, 0.10]	~0.00
BANPS care						0.02	0.05	>1	[−0.09, 0.12]	~−0.00
BANPS fear						−0.00	0.06	>1	[−0.12, 0.11]	~0.00
BANPS sadness						−0.06	0.07	>1	[−0.19, 0.06]	~−0.00
Condition [Nostalgia] × BANPS Play						0.06	0.06	>1	[−0.07, 0.19]	~0.00
Condition [Nostalgia] × BANPS Anger						0.06	0.06	>1	[−0.05, 0.17]	~0.00
Condition [Nostalgia] × BANPS Seek						−0.02	0.06	>1	[−0.14, 0.09]	~0.00
Condition [Nostalgia] × BANPS Care						−0.05	0.06	>1	[−0.17, 0.07]	~0.00
Condition [Nostalgia] × BANPS Fear						−0.05	0.07	>1	[−0.17, 0.08]	~0.00
Condition [Nostalgia] × BANPS Sadness						0.31	0.07	**<.001**	**[0.17, 0.46]**	0.006
Random effects										
σ^2	1.49					1.49				
τ_{00}	0.40_{id}					0.41_{id}				
ICC	0.21					0.22				
N	582_{id}					582_{id}				
Observations	2,234					2,234				
Marginal R^2/conditional R^2	0.034/0.236					0.032/0.241				

Note. Effect size is indicated with Cohen's f^2. Bold formatting indicates significance at $p < .05$. *SE* = standard error; *p*(adj.) = *p* value, adjusted using Bonferroni's correction; MIN = mixed valence, using the minimum function; CI = confidence interval; SNS = Southampton Nostalgia Scale; PANAS-SF = Positive and Negative Affect Schedule, Short Form; TIPI = Ten-Item Personality Inventory; BANPS = Brief Affective Neuroscience Personality Scales; id = participant level; ICC = intraclass correlation coefficient.

Figure 6

Person-Level Predictors of Felt High Arousal During Nostalgic and Control Music Conditions



Note. All plots are depicted using the model with BANPS. Predictors are mean-centered. Shaded bands represent 95% confidence intervals. Greater high arousal scores indicate increased feelings of high arousal while listening. SNS = Southampton Nostalgia Scale; PANAS = Positive and Negative Affect Schedule; BANPS = Brief Affective Neuroscience Personality Scales. See the online article for the color version of this figure.

Seehusen et al., 2013). This finding has sometimes been explained in terms of a "maladaptation view," a view proposed in the 17th century (for English translation, see Anspach, 1934) in which nostalgia is understood as a tendency to ruminate, retreating to the past to avoid the problems of the present (e.g., Garrido, 2018; Kaplan, 1987; Zinchenko, 2011). However, this view has little empirical support and is instead refuted by many pieces of counterevidence demonstrating the adaptive functions of nostalgia (Frankenbach et al., 2021; Hepper et al., 2024; Umar Ismail et al., 2020). Thus, we instead interpret this finding in terms of the Regulatory Model of Nostalgia (Wildschut & Sedikides, 2023), in which discomforting situations elicit nostalgia and the nostalgia alleviates discomfort (Wang et al., 2023, 2024). Individuals high in neuroticism, by definition, have a greater tendency to experience negative and discomforting feelings (Matthews et al., 1990; Rusting & Larsen, 1997). The fact that these individuals are also high in Trait Nostalgia suggests that they may utilize nostalgia to cope with these more frequent negative feelings and thus report nostalgia as a more frequently occurring and important emotion.

In addition to stability, we observed that Trait Nostalgia was positively correlated with extraversion and agreeableness. Previous work has shown that agreeableness, neuroticism, and openness are correlated with state-level felt nostalgia in response to audiovisual stimuli (Zhang et al., 2023), but to our knowledge, this is the first study to report this combination of personality characteristics as correlated with trait-level Trait Nostalgia. Here, we build a more complex personality profile of a highly nostalgic individual as one who is extraverted, agreeable, yet unstable (neurotic). We posit that the moderating factor that likely connects these personality traits is instead the social variable of need to belong (Allen et al., 2022; Baumeister & Leary, 2007; M. R. Leary et al., 2013). Need to belong refers to the desire for interpersonal attachments (Allen et al., 2022; Baumeister & Leary, 2007). Extraversion, agreeableness, and neuroticism alone significantly predict need to belong (M. R. Leary et al., 2013), that is, neurotic, agreeable extroverts appear to have *deficits* in their sense of belonging. This deficit then is associated with loneliness (Mellor et al., 2008), which triggers and is alleviated by nostalgia (Abeyta et al., 2020; Wildschut et al., 2006; Zhou et al., 2022) due to nostalgia's association with social experiences and memories (for review, see Juhl & Biskas, 2023; Sedikides & Wildschut, 2019). This is supported by Seehusen et al. (2013), in which the connection between neuroticism and Trait Nostalgia was moderated entirely by need to belong. Thus, the presence of extraversion and agreeableness as significant predictors of Trait Nostalgia, *in addition* to neuroticism, provides evidence for a regulatory (Wildschut & Sedikides, 2023) and social view of Trait Nostalgia (Seehusen et al., 2013).

Results from the BANPS measures additionally support this view. While Barrett et al. (2010) found positive correlations between Trait Nostalgia and the BANPS dimensions of seek and sadness, we found only positive correlations with play and care. These BANPS dimensions map very closely, in both our sample

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Table 11

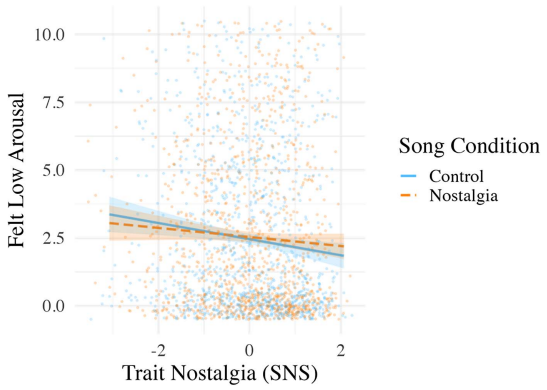
Results of Multilevel Models and Interactions of Context-Level and Person-Level Measures: High Arousal Ratings

Predictor	High arousal									
	β	*SE*	*p*(adj.)	95% CI	f^2	β	*SE*	*p*(adj.)	95% CI	f^2
(Intercept)	2.40	0.09	**<.001**	[2.22, 2.58]		2.40	0.09	**<.001**	[2.22, 2.58]	
SNS score	0.12	0.10	>1	[−0.07, 0.31]	~0.00	0.12	0.10	>1	[−0.08, 0.32]	~0.00
Condition [nostalgia]	3.89	0.10	**<.001**	[3.70, 4.09]	0.51	3.90	0.10	**<.001**	[3.71, 4.09]	0.52
PANAS-SF positive	0.47	0.12	**<.001**	[0.23, 0.71]	~0.00	0.49	0.12	**<.001**	[0.25, 0.73]	~−0.00
PANAS-SF negative	0.16	0.12	.875	[−0.07, 0.38]	~−0.00	0.13	0.12	>1	[−0.10, 0.36]	~0.00
TIPI extraversion	−0.15	0.11	.810	[−0.36, 0.06]	~0.00					
TIPI agreeable	0.03	0.10	>1	[−0.16, 0.23]	~0.00					
TIPI conscientious	−0.04	0.11	>1	[−0.25, 0.17]	~0.00					
TIPI stability	0.03	0.13	>1	[−0.21, 0.28]	~0.00					
TIPI openness	0.02	0.10	>1	[−0.18, 0.22]	~0.00					
SNS Score × Condition [Nostalgia]	0.35	0.10	**.01**	[0.15, 0.55]	0.004	0.37	0.11	**.003**	[0.16, 0.36]	0.004
Condition [Nostalgia] × PANAS-SF Positive	−0.15	0.13	>1	[−0.41, 0.11]	~0.00	−0.34	0.13	**.043**	[−0.60, −0.09]	0.002
Condition [Nostalgia] × PANAS-SF Negative	−0.14	0.12	>1	[−0.38, 0.10]	~0.00	0.01	0.12	>1	[−0.24, 0.25]	~−0.00
Condition [Nostalgia] × TIPI Extraversion	0.08	0.11	>1	[−0.14, −0.31]	~0.00					
Condition [Nostalgia] × TIPI Agreeable	0.05	0.11	>1	[−0.16, 0.26]	~−0.00					
Condition [Nostalgia] × TIPI Conscientious	0.05	0.12	>1	[−0.17, 0.28]	~−0.00					
Condition [Nostalgia] × TIPI Stability	−0.07	0.13	>1	[−0.32, 0.19]	~−0.00					
Condition [Nostalgia] × TIPI Openness	−0.07	0.11	>1	[−0.28, 0.14]	~0.00					
BANPS play						0.02	0.12	>1	[−0.20, 0.25]	~−0.00
BANPS anger						−0.14	0.10	.865	[−0.33, 0.06]	~0.00
BANPS seek						−0.04	0.10	>1	[−0.24, 0.16]	~0.00
BANPS care						−0.14	0.11	>1	[−0.35, 0.08]	~−0.00
BANPS fear						0.02	0.12	>1	[−0.21, 0.25]	~−0.00
BANPS sadness						0.10	0.13	>1	[−0.16, 0.36]	~0.00
Condition [Nostalgia] × BANPS Play						−0.11	0.12	>1	[−0.36, 0.13]	~0.00
Condition [Nostalgia] × BANPS Anger						0.41	0.10	**<.001**	[0.20, 0.61]	0.005
Condition [Nostalgia] × BANPS Seek						0.08	0.11	>1	[−0.13, 0.29]	~0.00
Condition [Nostalgia] × BANPS Care						0.36	0.12	**.01**	[0.13, 0.59]	0.003
Condition [Nostalgia] × BANPS Fear						−0.31	0.13	.065	[−0.56, −0.07]	0.002
Condition [Nostalgia] × BANPS Sadness						−0.26	0.14	.285	[−0.54, 0.01]	~0.00
Random effects										
σ^2	5.44					5.35				
τ_{00}	2.00_{id}					2.02_{id}				
ICC	0.27					0.27				
N	582_{id}					582_{id}				
Observations	2,234					2,234				
Marginal R^2/conditional R^2	0.354/0.528					0.361/0.536				

Note. Effect size is indicated with Cohen's f^2. Bold formatting indicates significance at $p < .05$. *SE* = standard error; *p*(adj.) = *p* value, adjusted using Bonferroni's correction; CI = confidence interval; SNS = Southampton Nostalgia Scale; PANAS-SF = Positive and Negative Affect Schedule, Short Form; TIPI = Ten-Item Personality Inventory; BANPS = Brief Affective Neuroscience Personality Scales; id = participant level; ICC = intraclass correlation coefficient.

Figure 7

Person-Level Predictors of Felt Low Arousal During Nostalgic and Control Music Conditions



Note. Trait Nostalgia is mean-centered. Shaded bands represent 95% confidence intervals. Greater low arousal scores indicate increased feelings of low arousal (or decreased arousal) while listening. SNS = Southampton Nostalgia Scale. See the online article for the color version of this figure.

and in Barrett et al.'s (2010) study, onto the big factor metrics of neuroticism (correlated positively with sadness), extraversion (correlated positively with play, care, and seek), and agreeableness (correlated positively with play, care, and seek). This provides further evidence for a combined regulatory and social model of Trait Nostalgia.

We posit that Barrett et al. (2010) may not have observed the same expanded profile of personality characteristics associated with Trait Nostalgia due to their more limited sample of northern California college students. College students likely provide less variance in personality traits compared with the more diverse, national sample included in this investigation. Thus, expanding the original work to include individuals across the age spectrum, who are more racially and ethnically diverse, and from distributed geographical locations allows for a more representative exploration of personality.

Limitations and Future Directions

We acknowledge several limitations of the present study. First, we note that this investigation was not a *direct* replication of Barrett et al.'s (2010) study. We used updated versions of several measures, administered person-level measures *after* music listening, rather than before music listening, and used a categorical, rather than continuous, measure of nostalgia-evoking and control songs, fundamentally altering the structure of many analyses. We additionally utilized different definitions of several concepts (nostalgia-evoking song, arousal). We opted to use an activation-based arousal definition to capture embodied feeling states (Nummenmaa et al., 2014) but recognize that this change in definition makes comparisons between the present study and Barrett et al.'s (2010) arousal findings challenging. We believe that these differences, however, allow for extended insights on music-evoked nostalgia while remaining a conceptual, but not exact, replication of Barrett et al.'s (2010) study. Future studies could consider adding even more latest measures to highlight the nuances of nostalgic experience. For example, since the conceptualization of the present study, Newman et al. (2020) developed and validated the Personality Inventory of Nostalgic Experiences scale to assess trait and state nostalgic experiences, which may provide additional information on person-level factors that influence music-evoked nostalgia.

While the present study examined the differing affective experiences of music-evoked nostalgia using valence and arousal dimensions, we note that doing so *after* listening to the song poses some limits to the depth of our understanding of this emotion. Reflecting upon emotional states after the emotional experience may impact the experience and reporting of such experiences. Future work could implement continuous measures of nostalgia, valence, and arousal, in which participants can give moment-to-moment reports of their feelings while experiencing them. This method has been employed to investigate univariate music-evoked emotions (Sachs et al., 2020; Vuoskoski et al., 2022) and could provide additional insight into the dynamics of music-evoked nostalgia.

Additionally, we acknowledge the limitations of some of the measures utilized in this investigation, namely, the TIPI (Gosling et al., 2003). This scale is useful due to its short form, allowing it to be included in long batteries of measures (as performed in this study). However, it has been criticized due to its overall poor internal consistency (for review, see Thørrisen & Sadeghi, 2023) and use of multidescriptor items (containing two adjectives), which may increase ambiguity for participants and reduce reliability and validity (Herzberg & Brähler, 2006; Schult et al., 2019). Due to the length of this study for participants, we opted to use a short-form scale to assess the Big Five personality traits, but future work may consider using a longer-form scale with overall better psychometric properties.

Last, we note that, while reported findings are statistically significant, the effect sizes observed in the present study were small (mostly <0.2). This was particularly true for models investigating the interaction between person- and context-level variables, and thus such results should be taken with caution. However, we believe that observed significant effects, while small, still provide meaningful implications for our understanding of music-evoked nostalgia.

Constraints on Generality

The primary purpose of this study was to conceptually replicate and extend the work of Barrett et al. (2010) in a larger and more diverse sample. While our sample consisted of a larger number of individuals, recruited from across the United States, we note that we did not specifically sample representatively in terms of age, ethnic identity, or racial identity. Given this, and that we additionally did not collect ethnic or racial identity information from the participants, our findings are not necessarily generalizable to the population of the United States. Future work should employ a statistically representative sample to accomplish this goal. This is especially relevant, given that much of the focus of current music-evoked emotion and memory research today focuses on older adults and those with Alzheimer's disease and related dementias (Edwards et al., 2023; Kaiser & Berntsen, 2023;

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Table 12

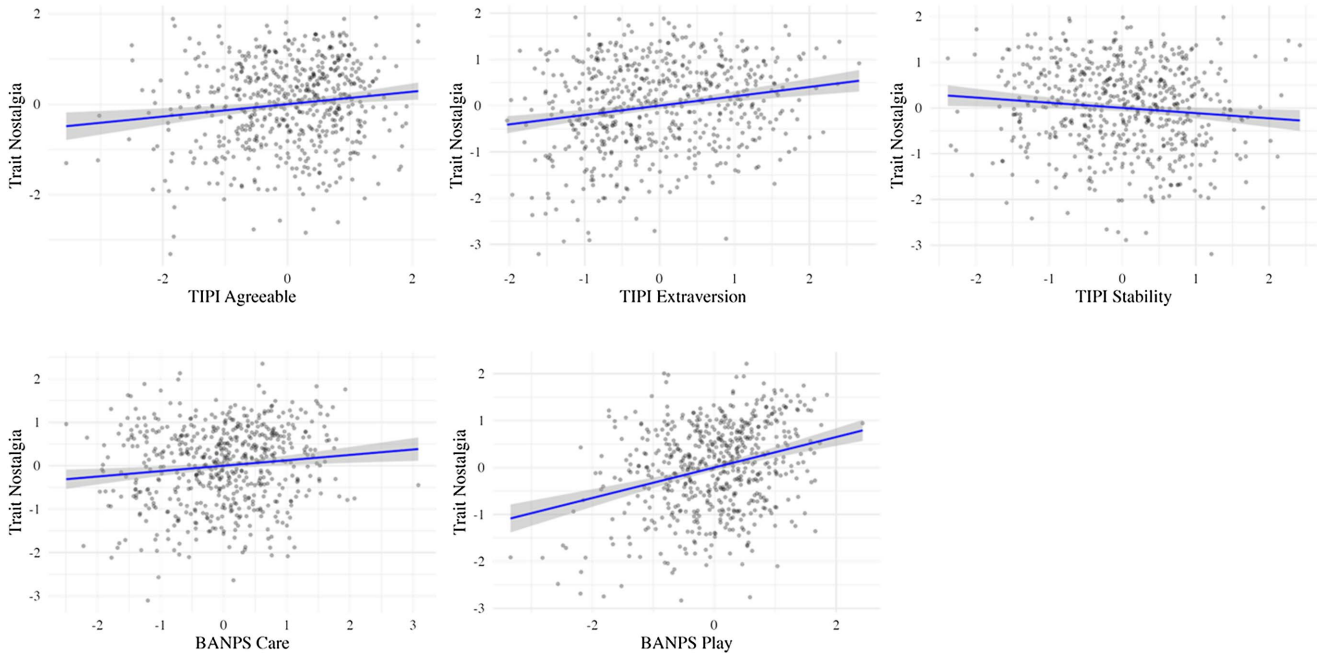
Results of Multilevel Models and Interactions of Context-Level and Person-Level Measures: Low Arousal Ratings

Predictor	Low arousal									
	β	*SE*	*p*(adj.)	95% CI	f^2	β	*SE*	*p*(adj.)	95% CI	f^2
(Intercept)	2.46	0.10	**<.001**	[2.27, 2.66]		2.47	0.10	**<.001**	[2.28, 2.66]	
SNS score	−0.30	0.10	**.022**	[−0.50, −0.09]	~0.00	−0.28	0.11	.054	[−0.49, −0.07]	~−0.00
Condition [nostalgia]	0.08	0.11	>1	[−0.14, 0.30]	~0.00	0.07	0.11	>1	[−0.15, 0.29]	~0.00
PANAS-SF positive	−0.03	0.13	>1	[−0.29, 0.23]	~0.00	−0.07	0.13	>1	[−0.33, 0.19]	~0.00
PANAS-SF negative	0.06	0.12	>1	[−0.18, 0.30]	~0.00	0.13	0.12	>1	[−0.11, 0.37]	~−0.00
TIPI extraversion	0.07	0.11	>1	[−0.15, 0.30]	~0.00					
TIPI agreeable	0.06	0.11	>1	[−0.15, 0.27]	~0.00					
TIPI conscientious	0.04	0.12	>1	[−0.18, 0.27]	~0.00					
TIPI stability	0.00	0.13	>1	[−0.26, 0.26]	~0.00					
TIPI openness	0.06	0.11	>1	[−0.15, 0.27]	~0.00					
SNS Score × Condition [Nostalgia]	0.13	0.12	>1	[−0.10, 0.36]	~0.00	0.10	0.12	>1	[−0.13, 0.34]	~0.00
Condition [Nostalgia] × PANAS-SF Positive	−0.12	0.15	>1	[−0.41, 0.18]	~0.00	0.03	0.15	>1	[−0.26, 0.32]	~0.00
Condition [Nostalgia] × PANAS-SF Negative	−0.01	0.14	>1	[−0.29, 0.26]	~0.00	−0.16	0.14	>1	[−0.43, 0.12]	~0.00
Condition [Nostalgia] × TIPI Extraversion	−0.02	0.13	>1	[−0.27, 0.23]	~0.00					
Condition [Nostalgia] × TIPI Agreeable	−0.13	0.12	>1	[−0.36, 0.11]	~0.00					
Condition [Nostalgia] × TIPI Conscientious	−0.01	0.13	>1	[−0.26, 0.25]	~−0.00					
Condition [Nostalgia] × TIPI Stability	−0.03	0.15	>1	[−0.32, 0.27]	~0.00					
Condition [Nostalgia] × TIPI Openness	0.17	0.12	>1	[−0.06, 0.41]	0.001					
BANPS play						−0.06	0.12	>1	[−0.30, 0.18]	~−0.00
BANPS anger						−0.08	0.11	>1	[−0.28, 0.13]	~−0.00
BANPS seek						0.05	0.11	>1	[−0.16, 0.26]	~−0.00
BANPS care						0.20	0.12	.45	[−0.03, 0.43]	~−0.00
BANPS fear						−0.25	0.13	.26	[−0.49, 0.00]	~−0.00
BANPS sadness						0.03	0.14	>1	[−0.24, 0.30]	~−0.00
Condition [Nostalgia] × BANPS Play						0.11	0.14	>1	[−0.16, 0.38]	~−0.00
Condition [Nostalgia] × BANPS Anger						−0.11	0.12	>1	[−0.34, 0.13]	~0.00
Condition [Nostalgia] × BANPS Seek						0.18	0.12	.69	[−0.06, 0.42]	~0.00
Condition [Nostalgia] × BANPS Care						−0.29	0.13	**.155**	[−0.55, −0.03]	0.002
Condition [Nostalgia] × BANPS Fear						0.21	0.14	.685	[−0.07, 0.49]	0.001
Condition [Nostalgia] × BANPS Sadness						0.28	0.16	.365	[−0.03, 0.59]	0.001
Random effects										
σ^2	5.44					6.86				
τ_{00}	2.00_{id}					1.91_{id}				
ICC	0.27					0.22				
N	582_{id}					582_{id}				
Observations	2,234					2,234				
Marginal R^2/conditional R^2	0.354/0.528					0.018/0.231				

Note. Effect size is indicated with Cohen's f^2. Bold formatting indicates significance at $p < .05$. *SE* = standard error; *p*(adj.) = *p* value, adjusted using Bonferroni's correction; CI = confidence interval; SNS = Southampton Nostalgia Scale; PANAS-SF = Positive and Negative Affect Schedule, Short Form; TIPI = Ten-Item Personality Inventory; BANPS = Brief Affective Neuroscience Personality Scales; id = participant level; ICC = intraclass correlation coefficient.

Figure 8

Predictors of Trait Nostalgia



Note. Plots are depicted controlling for other factors presented in the models. Predictors and Trait Nostalgia are mean-centered for visualization purposes. Shaded bands represent 95% confidence intervals. Plots depicted partial correlations. TIPI = Ten-Item Personality Inventory; BANPS = Brief Affective Neuroscience Personality Scales. See the online article for the color version of this figure.

Matziorinis & Koelsch, 2022). Second, our study is limited in that it only sampled individuals from the United States, limiting generalizability. Music-evoked nostalgia is a cross-cultural phenomenon (Hanson et al., 2022; Saarikallio et al., 2021), and our understanding of this construct is largely limited to Western cultures and music. Given the breadth of musical expressions (Athanasopoulos et al., 2021; Jacoby et al., 2019; Mehr et al., 2019) and emotional constructs (Jackson et al., 2019; Mesquita et al., 2016) across the globe, future work should explore this topic cross-culturally.

Conclusion

In this study, we conceptually replicated the majority of findings observed by Barrett et al. (2010) in a larger sample of adults from

Table 13

Results of Linear Regressions and Person-Level Measures to Predict Trait Nostalgia (Southampton Nostalgia Scale)

	SNS score									
Predictor	β	*SE*	*p*	95% CI	f^2	β	*SE*	*p*	95% CI	f^2
(Intercept)	4.85	0.04	**<.001**	[4.77, 4.92]		4.85	0.04	**<.001**	[4.77, 4.92]	
TIPI extraversion	0.20	0.04	**<.001**	[0.12, 0.29]	0.039					
TIPI agreeable	0.14	0.04	**.001**	[0.05, 0.22]	0.018					
TIPI conscientious	0.06	0.04	.192	[−0.03, 0.14]	0.003					
TIPI stability	−0.11	0.05	**.013**	[−0.20, −0.02]	0.011					
TIPI openness	0.06	0.04	.165	[−0.02, 0.14]	0.003					
BANPS play						0.32	0.04	**<.001**	[0.24, 0.41]	0.093
BANPS anger						−0.01	0.04	.812	[−0.09, 0.07]	∼−0.00
BANPS seek						−0.03	0.04	.416	[−0.11, 0.05]	0.001
BANPS care						0.12	0.04	**.004**	[0.04, 0.21]	0.014
BANPS fear						0.00	0.05	.945	[−0.09, 0.10]	∼−0.00
BANPS sadness						0.09	0.05	.067	[−0.01, 0.18]	0.006
Observations	582					582				
R^2/R^2 adjusted	0.082/0.074					0.158/0.149				

Note. Effect size is indicated with Cohen's f^2. Bold formatting indicates significance at $p < .05$. SNS = Southampton Nostalgia Scale; *SE* = standard error; CI = confidence interval; TIPI = Ten-Item Personality Inventory; BANPS = Brief Affective Neuroscience Personality Scales.

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across the United States while controlling for musical features and song familiarity. In addition to replicating Barrett et al.'s (2010) study, this study provides several unique contributions to our understanding of music-evoked nostalgia. First, we demonstrate that self-selected music is effective at inducing nostalgia and for which it is relatively simple to obtain appropriate control stimuli. Second, we observe that the subjective experience of music-evoked nostalgia is different from the subjective experience of musically matched, familiar pieces of music and may vary depending on each individual's unique combination of personality characteristics. Last, we expand the personality profile typically associated with high Trait Nostalgia to include a more complex portrayal of an individual consistent with profiles of individuals seeking social belongingness.

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